TOTAL ECLIPSES OF THE SUN.

With Some Reference to the Next Eclipse Visible in the Southern States, May 28, 1900.

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Were it possible for us to see shadows against the sky, and to take up out in space a position suitable for the purpose, we should perceive that both the earth and the moon cast behind them vast black cones pointed away from the sun, the common source of illumination. Could we measure these cones, we should find that the shadow of the earth is 850,000 miles, and that the shadow of the moon is 238,000 miles in average length. The moon's path is far from being exactly circular. It is elliptical, or egg-shaped, so that while the distance which separates the earth and moon from each other averages 240,000 miles, there are days when she is only 222,000 miles away, and other days when she is as far off as 252,000 miles, a difference of 50,000 miles. And this is the reason that, to the naked eye, our satellite at times appears to be larger or smaller than at other times. Any one who follows her through a sufficient number of lunations will detect not only these but other interesting differences, and will notice that she never "fulls" twice in the same part of the sky, because she is constantly changing her position by rising or falling from night to night, thus passing, as it were, every month, through many degrees of north and south declination. And it will be further observed that, in obedience to some law, the moon in our Summers becomes full at or near her lowest point as she hangs over the Southern horizon, and in our Winters at her highest point over our heads, thus providentially affording light to that pole, for the time being, most in need of it. An eclipse of the sun visible to us can occur only when the moon is new, that is, when she passes exactly between us and the sun, just as one might pass his clenched hand from right to left between his face and a lighted lamp. Now, if an eclipse happen when she is at her least distance, 220,000 miles, from us, and, therefore apparently greatest in diameter, the apex or point of her shadow-cone will come in contact with the surface of the earth, and be broken off to the extent of some thousands of miles. If, however, one happens when the moon is at her greatest distance, 252,000 miles from us, and, therefore, apparently least in diameter, the apex of the shadow will pass over our heads at a distance of many thousands of miles, and somewhat after the fashion of a balloon floating by at a considerable height. In the first instance, the eclipse will be total along the path more or less curved, over which the broken shadow travels, because the moon will be large enough to hide the sun. In the second, the eclipse will be annular, because the moon will have been, by her distance, apparently diminished to that degree that at no instant while she is crossing the solar disk, can she completely obscure it, for around her coal-black body will blaze a ring of the white-hot sun.

Of the stupendous scale of total eclipses, moon-cast shadow-apparitions are impressive and awful to the last degree; they are phenomena never forgotten by those who see them. Than Prof. Langley there is no better authority, he having observed three. No wonder he declares that repetition does not dull the interest, and that a total eclipse of the sun is worth a journey round the world to behold.

For the purpose of observing these phenomena, scientific men and women do not hesitate, literally, to go to the ends of the earth. Especially promising eclipses have found enthusiastic observers on the steppes of Russia, the wastes of Asia, the inhospitable shores of Africa, the peaks of the Andes, the lonely rocks in mid-Pacific. The total phase is the only portion of a solar eclipse of the slightest value to astronomers or solar physicists, or, indeed, of real interest to the mere sight-seer, and this phase, under the best possible conditions, cannot at any one place last so long as eight minutes; commonly, the duration does not exceed three minutes. Notwithstanding this, and the chance of complete failure, owing to the presence of clouds, costly expeditions are from year to year fitted out by governments, observatories, societies and private munificence, and the arduous duties devolving upon them are ungrudgingly assumed by men eager to glean from the sky every vestige of information obtainable by telescope, spectroscope and camera during the few precious moments that the obscuration of the sun is sufficiently complete to allow critical examination to be made of the solar appendages, visible to man only when daylight has been thus temporarily turned into night. Readers of the *Scientific American* will, therefore, readily appreciate the keen interest with which scientific men and women on this continent are looking forward to the next total eclipse, which, most fortunately for them, will, on the 28th of May, 1900, be visible in Mississippi, Alabama, Georgia, South Carolina, North Carolina and Virginia, or, in other words, throughout a broad belt, extending from New Orleans to Cape Henry.

The shadow-path of the approaching solar eclipse will cross the American continent, and, within the United States, will cover a belt fifteen hundred miles long by about forty miles wide at New Orleans, and sixty miles wide at Cape Henry. Observers should, if possible, take up positions on the central line of the path, as the shadow will there be densest, and the phenomena best seen. Along this central line, and within the north and south limits of the path, there will be thousands of excellent stations. From every city, town, village, hamlet and farm throughout the belt observations may be made to great advantage. The best positions will be found in the moon's path from the Appalachian highlands on to the Atlantic coast. Some of these have already been selected by professional astronomers, who have chosen localities likely to be most free from cloud. These ladies and gentlemen will take care to be on the ground several days in advance, so as to arrange their instruments and drill their staffs to the last degree of thoroughness and precision. No doubt the unprofessional men and women who will be present on eclipse day will number many thousands. Well-equipped parties will go South and East from all parts of the continent, not excepting Canada. At least one official party will come out from England, while other parties from that and other countries will go to places in Europe and Africa. The eclipse will be total along a path extending from a point near the Southern end of Lower California, across Mexico, the United States, the Atlantic, twice cutting the path of ocean travel, Portugal, Spain, Algiers and Egypt. Outside of this path the eclipse will, some time during the day, be more or less partial to observers from the North Pole to the river Amazon and from the central Pacific Ocean to the Red Sea.

On the 28th of May next, sometime after local sunrise, the round, black shadow of the moon, like a great arm will sweep in out of space, coming in contact with the earth near the Revilla Gigedo Islands in the Pacific Ocean, about five hundred miles south and west of California. With the tremendous initial velocity of about one hundred miles a minute, the shadow-cone will rush toward the mainland and enter Mexico near Cape Corrientes. In eight minutes it shall have crossed the Rocky Mountains, where, flying from peak to peak and from valley to valley, the spectacle must be sublime, though lasting but thirty seconds. By 7:30 Central Standard time (or 8:30 Eastern Standard time) it shall have crossed the Gulf near the mouth of the Rio Grande and plunged New Orleans into sepulchral gloom.

For the purpose of anticipation and study, let us imagine ourselves to be members of a group of enthusiastic men, women and youths, not necessarily scientific or practiced observers, only anxious to see everything possible. We should be posted upon the highest possible eminence, so as not to miss the tremendous impressions due to the sudden rushing upon us of the stupendous shadow. We ought to be in the center of the ground over which the shadow will pass. If this position be near New Orleans, we shall have totality for seventy-seven seconds. If we are at Union Point, Greene County, Georgia, the center of the path in the United States, we shall have darkness for ninety-two seconds. If we are near the Atlantic coast, not far south of the city of Norfolk, we shall have one hundred and five seconds for observation. Let us assume that we have brought with us opera and field glasses, telescopes, spectroscopes, barometers, thermometers, and well regulated timepieces, set to Washington, Greenwich, and local times. Of course, we have note-books, pads of drawing-paper, cardboard, white and blackened, upon which have been laid down black disks, around which our artistic members, by rapid sketching with colored chalks, may draw the phenomena we shall see. We have candles and lanterns, the latter for use if the wind arise. Of course, we have cameras and plates of various speeds and densities of coating. We have seen the beautiful photographs taken on the 22d of January, 1898, in India, by Mrs. E. W. Maunder, with a small camera having a one and one-half lens, nine inches in focus, photographs due entirely to her own conception of what might be accomplished with such a camera, and which have proved of scientific value. The images were small, but from them excellent drawings have been made. We have everything in readiness. Instruments are mounted or suspended. Cameras have been focused, the most distant objects being used for the purpose. Thermometers have been placed so that we shall be able to take the temperature of the air and soil; we have been told off by our director, who has given each of us some special duty to perform, and who ought to have knowledge sufficient to tell us what to look for and to explain the various phenomena as they come under our notice. Timepieces and thermometers must be read; information as to exposing plates must be given; the moments of contact announced, and the seconds during totality called off in a loud voice. And though we are all assisting, we shall be able to see everything. Professional astronomers will not be so fortunate. They must be in constant attendance upon their instruments, and will probably work behind screens shutting them off from the world, so that their attention shall not be distracted.

From our calculations, we know when the various contacts will occur. The sun is about three hours high, and the sky clear. We are told that the edge of the lunar disk is all but touching the edge of the sun, but we cannot detect the presence of our satellite. It has been explained to us that the moon is really moving toward the East and at the rate of about a half mile per second, that the surface of the earth is carrying us toward the East at the speed of about twelve miles per minute, and that the shadow is approaching us from the West at the velocity of nearly one mile a second. During the hour and twelve minutes which must elapse between the first detected cutting by the moon into the sun's limb and totality, we shall have ample opportunity to observe and draw sun-spots and faculae, if any, to note down our impressions, to estimate the effect the gradual extinction of the direct solar rays is having upon objects around us, and the falling of the mercury in the thermometers. As totality approaches we should be on the alert for the shadow bands which are usually present in bewildering array for a few moments before the face of the sun is hidden, pulsating, it is said, in a manner to suggest the throes of nature in dissolution, and as if conscious of impending disaster. Nor should we forget to notice the effects of increasing twilight upon animals, birds, insects and flowers. On such occasions domestic fowls go to roost, birds return to their nests, butterflies "act as if drunk," deer run about in alarm, and flowers, such as crocus, tulips, anemones, gentians, pepatica, pimpernels, wood sorrel and wild geranium close, and a peculiar hush falls upon everything. At this moment attention must be given to the sun, or what is left of it, for we must see the splendid phenomena known as Baily's Beads, visible for an instant or two as the moon's advancing edge closes in upon the eastern edge of the sun, but visible again when the western edge of the moon moves forward just enough to allow the solar rays to glint around at us through the valleys among the lunar mountains.

But when warned by our director, every eye must be turned to the West, for whatever else we succeed in doing, we must not fail to see the lunar shadow as it approaches. We may not live long enough to witness another eclipse under such auspices. Let us make the most of this. Forbes, who observed at Turin, the total eclipse of 1842, said that he was confounded by the awful velocity of the shadow, which swept toward him from the Alps, that he felt as if the great building upon which he was standing swayed beneath him and began to fall over in the direction of the coming gloom. The rapidity of its motion and its black intensity produced the sensation that something material was flying over the earth at a speed "perfectly frightful," and he involuntarily listened for the rushing noise of a mighty wind. Airy describes as "very awful" a shadow retreating away among the hills of Northern Spain. Other writers are no less dramatic in their accounts of these phenomena, and the tremendous impression they create. But when the shadow has come, and after we have recovered to some degree from the effects of shock, and of the sudden darkness into which we have been plunged, we must rivet our attention upon the sun, or rather upon the moon, around whose black disk by this time will have appeared the splendid phenomena associated with a total solar eclipse, seen in all its majesty. Striking indeed is the almost instantaneous substitution, as in a dissolving lantern, of one picture for another, the one showing the sky with the blackened sun like a blot upon it, the other showing the sky suddenly draped in the mantle of night, upon whose sable bosom glow planet, star and coronal halo, and also roseate jets of incandescent gaseous matter leaping upward from and falling back upon the sun.

Now we photograph, sketch and color most assiduously, not losing a single second. We lay down the positions of planets, comets, if any, and of bright stars. The eclipse is taking place in the constellation of Taurus, between the fine red star of Aldebaran and the Pleiades. We look to see whether Aldebaran is able to make its presence known by shining through the gauzy structure of the corona, and how many of the bright stars in Orion and other constellations can be detected. We glance about the horizon and note the rich color-tones, ranging from black, in the zenith, through browns, purples, crimsons, and reds, to yellow lying along the rough sky-line thirty miles away, where the sun is still shining, though with a partially-hidden disk. We notice the ashy tints around us, reflected in our own faces. But a sudden glow along the western edge of the moon warns us that totality has gone like a flash, and that we have time only for a quickly exposed photographic plate or two, and for watching another lovely dissolving view, the fading out of night before the all-conquering day. Almost instantly the landscape brightens and becomes familiar. Not until now, as we feel the warmth of the solar rays, did we suspect a passing chill. New life throbs everywhere. The black lunar shadow has swept majestically by us and is already out on the Atlantic, rushing toward Europe. Its vast track behind us is sprinkled with thousands of people, spell-bound by the wondrous vision vouchsafed them by Nature, who, for a moment, as it were, has lifted but a corner of her robe and allowed them to gaze upon glories, the impressions of which will never fade from memory.

Farming in Europe and in America.

Each nation has something to learn of other nations, as each farmer has something to learn of his neighbor. Europe is greatly interested in our various experiments and in our agricultural bureau, and our agents are carefully observing the improvements going on abroad.

Prof. W. M. Hayes, who has been in Europe this summer observing the agricultural schools abroad, says:

"Germany is far ahead of us in forestry schools and in a sensible forestry system. Her great Forestry School at Eberswalde, in the pine regions north of Berlin, and the forests managed by its professors, are so well developed that our young men should go there to complete their forestry education. Germany's other experiment stations are each much narrower in their scope than ours, but some of them are doing good work. At Bremen, for instance, there is a station devoted wholly to the study of peat lands."

Comparing our agricultural schools with those of Europe, the Professor says:

"We have more money and improvement is going on at a more rapid rate here. In some things a few of their older institutions have done more, but we are ahead in most things, and our organization is on a broader plan, so we shall soon leave them far behind. America's experiment stations and colleges are building up such a vast science of agriculture as has not been dreamed of elsewhere. Our colleges each have several directors of experiments, while in Europe each has only one director with assistants."

Of the development of the sugar beet Prof. Hayes says:

"The breeding of sugar beet seed is the most scientific breeding done in the world. Sugar beets now contain more than twice as much sugar per acre as forty years ago. One firm employs two hundred people for two months in the winter analyzing mother beets for the next year's seed crop."

This is interesting in itself, and it shows, moreover, what may be done with other crops; with cotton, with wheat, with corn, with berries, tomatoes and various products of the soil.

Furthermore, all this gives new interest and new dignity to life on the farm. The world must be fed and fed each generation more abundantly. To do this work well the farmer must put his mind as well as his strength into his work, and try each year to show some advance in knowledge.—*Home and Farm.*

— One-tenth of the world is still unexplored.

A Hard Word to Say.

In the heat of passion Robert had done something that he was ashamed of and sorry for after the excitement. "I wish I hadn't let my temper get away with my good sense," he said, "but it's done and can't be undone."

"But isn't there no way to overcome the effect of wrongdoing to a great extent?" asked a voice in the heart.

"How?" asked Robert.

"By owning to one's blame in the matter," answered the voice. "Confessing one's fault does much to set wrong right. Try it."

Now, Robert was very much like the rest of us; he hated to admit that he was in fault. "I'm wrong; forgive me," is a hard thing to say.

But the more he though the matter over the more he felt that he ought to say just that. "It is the right thing to do," he told himself. "If I know what's right and don't do it, I'm a moral coward. I'll do it."

So he went to the one he had wronged and confessed his fault frankly. The result was that the two boys were better friends than before, and his comrade had a greater respect for him because he had been brave enough to do a disagreeable thing when it was presented to him in the light of duty.

My boys, remember that there's quite as much bravery in doing right for right's sake as there is in the performance of grand and heroic deeds the world will hear about.—*Eben E. Rexford in Christian Witness.*

Naming the Baby.

"Charlie! dear," said the young mother, "I've decided on a name for baby. We will call her Imogen."

Papa was lost in thought for a few minutes. He did not like the name, but if he opposed it his wife would have her own way.

"That's nice," said he, presently. "My first sweetheart was named Imogen, and she will take it as a compliment."

"We will call her Mary, after my mother," was the stern reply.

— Women are not permitted to be photographed in China.